CLAIMS

1. A weld joint comprising a first workpiece, a second workpiece, and a weld body joining said first workpiece and said second workpiece, which weld body is substantially free of tension anomalies, and comprises an area attributable to a higher order pass that comprises substantially pure nickel.

2. A weld joint as in Claim 1, wherein said area attributable to a higher order pass comprises greater than or equal to approximately 83.5% nickel.

3. A weld joint as in Claim 1, wherein said area attributable to a higher order pass comprises greater than or equal to approximately 90% nickel.

4. A weld joint comprising a first work segment, a second work segment, and a weld body joining said first workpiece and said second workpiece, said weld body having an average of four or fewer tension anomalies visible to a naked eye per square inch, said weld body comprising an area attributable to a higher order pass that comprises substantially pure nickel.

5. A weld joint as in Claim 4, wherein said area attributable to a higher order pass comprises greater than or equal to approximately 83.5% nickel.

6. A weld joint as in Claim 4, wherein said area attributable to a higher order pass comprises greater than or equal to approximately 90% nickel.

7. A weld joint as in Claim 4, wherein said weld body has an average of three or fewer tension anomalies visible to a naked eye per square inch.

8. A weld joint as in Claim 7, wherein said area attributable to a higher order pass comprises greater than or equal to approximately 83.5% nickel.

9. A weld joint as in Claim 7, wherein said area attributable to a higher order pass comprises greater than or equal to approximately 90% nickel.

10. A weld joint as in Claim 4, wherein said weld body has an average of two or fewer tension anomalies visible to a naked eye per square inch.

11. A weld joint as in Claim 10, wherein said area attributable to a higher order pass comprises greater than or equal to approximately 83.5% nickel.

12. A weld joint as in Claim 10, wherein said area attributable to a higher order pass comprises greater than or equal to approximately 90% nickel.

13. A weld joint as in Claim 4, wherein said weld body has an average of one or fewer tension anomalies visible to a naked eye per square inch.

14. A weld joint as in Claim 13, wherein said area attributable to a higher order pass comprises greater than or equal to approximately 83.5% nickel.

15. A weld joint as in Claim 13, wherein said area attributable to a higher order pass comprises greater than or equal to approximately 90% nickel.

16. A weld comprising a higher order pass, and having a gradient of nickel purity as measured along a throat of said weld that generally increases between a root of said weld and a point within said higher order pass.

17. A weld comprising a second order pass and a plurality of higher order passes, said plurality of higher order passes comprising at least a third order pass and a fourth order pass, the weld having a gradient of nickel purity that generally increases from a second order pass through said third order pass and said fourth order pass.

18. A weld comprising a higher order pass, and having a gradient of nickel purity as measured along a throat of said weld that generally increases as the distance from a root of said weld increases, a face of said weld having an average of four or fewer tension anomalies visible to a naked eye per square inch .

19. A weld as in Claim 18, wherein the face of said weld has an average of three or fewer tension anomalies visible to a naked eye per square inch.

20. A weld as in Claim 18, wherein the face of said weld has an average of two or fewer tension anomalies visible to a naked eye per square inch.

21. A weld as in Claim 18, wherein the face of said weld has an average of one or fewer tension anomalies visible to a naked eye per square inch.

22. A weld comprising a plurality of passes, which passes comprise a second order pass and at least one higher order pass; wherein a plurality of said passes generally increase in nickel purity as the order number increases; and wherein further the last of which passes to increase in nickel purity has an average of four or fewer tension anomalies visible to a naked eye per square inch..

23. A weld as in Claim 22, wherein the last of which second and higher order pass zones to increase in nickel purity has an average of three or fewer tension anomalies visible to a naked eye per square inch.

24. A weld as in Claim 22, wherein the last of which second and higher order pass zones to increase in nickel purity has an average of two or fewer tension anomalies visible to a naked eye per square inch.

25. A weld as in Claim 22, wherein the last of which second and higher order pass zones to increase in nickel purity has an average of one or fewer tension anomalies visible to a naked eye per square inch.

26. A method of producing a highly ductile weld, comprising the steps of:
    a. selecting a weld wire comprising substantially pure nickel
    b. fusing a weld bead of said weld wire onto a workpiece, whereby a first weld pass of weld bead is welded
    c. fusing to said first weld pass at least one weld pass of said weld wire, whereby an intermediary pass of weld bead is welded
    d. in the presence of a substantially pure inert gas, fusing to said intermediary pass at least one weld pass of said weld wire in a substantially undiluted condition.

27. A method of producing a highly ductile weld as in Claim 26, wherein said substantially pure inert gas comprises an inert gas in combination with reducing gasses.

28. A method of producing a highly ductile weld as in Claim 26, wherein said substantially pure inert gas comprises argon gas.

29. A method of producing a highly ductile weld as in Claim 26, wherein said substantially pure inert gas comprises argon gas in combination with reducing gasses.

30. The method of creating a welded ductile iron joint according to Claim 26, further comprising the step of abstaining from pre-heating, post-heating, or chemical antimartensitizing treatment of a heat affected zone.

31. The method of creating a welded ductile iron joint according to Claim 26, wherein at least one of steps b, c, and d is accomplished by a skip welding technique.

32. The method of creating a welded ductile iron joint according to Claim 26, wherein at least one of steps b, c, and d is accomplished using a liquid cooled welding torch.

33. The method of creating a welded ductile iron joint according to Claim 26, wherein at least one of steps b, c, and d is accomplished using a pulse MIG welder.

34. The method of creating a welded ductile iron joint according to Claim 26, wherein said fusing in at least one of steps b, c, and d occurs by means of spray transfer welding.

35. A method of producing a highly ductile weld, comprising the steps of:

a. selecting a weld wire comprising substantially pure nickel;

b. fusing by spray transfer a weld bead of said weld wire onto a workpiece using a liquid cooled welding torch operated in a skip welding technique, whereby a first weld pass of weld bead is welded;

c. fusing by spray transfer to said first weld pass at least one weld pass of said weld wire using a liquid cooled welding torch operated in a skip welding technique, whereby an intermediary pass of weld bead is welded;

d. in the presence of a substantially pure inert gas, using a liquid cooled welding torch operated in a skip welding technique to fuse by spray transfer to said intermediary pass at least one weld pass of said weld wire in a substantially undiluted condition.

36. The method of creating a welded ductile iron joint according to Claim 35, wherein at least one of steps b, c, and d is accomplished using a pulse MIG welder.

37. The method of creating a welded ductile iron joint according to Claim 35, further comprising the step of abstaining from pre-heating, post-heating, or chemical antimartensitizing treatment of a heat affected zone.

38. A method of producing a highly ductile weld as in Claim 35, wherein said substantially pure inert gas comprises an inert gas in combination with reducing gasses.

39. A method of producing a highly ductile weld as in Claim 35, wherein said substantially pure inert gas comprises argon gas.

40. A method of producing a highly ductile weld as in Claim 35, wherein said substantially pure inert gas comprises argon gas in combination with reducing gasses.

41. A method of creating a welded ductile iron joint having a yield strength of less than about 35000 psi, comprising compensating for a brittleness of a heat affected zone by creating a highly ductile weld bead.

42. The method of creating a welded ductile iron joint according to Claim 41, wherein said heat affected zone is not subjected to any of pre-heating, post-heating, or chemical antimartensitizing treatment.

43. The method of Claim 41 wherein said creating a highly ductile weld bead comprises using a filler metal or a consumable electrode of a high ductility material consisting essentially of nickel.